Designing and Using Historical Vignettes in Science Teaching: A Personal Account

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Biography

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Abstract

Historical vignettes are interesting short stories which encapsulate a brief period of scientific history. They can be useful tools for teaching the nature of science, demonstrating the practices of science and making science fun. Historical vignettes illustrate the role of people and social processes in science.

In this paper I describe my experience with writing and presenting an historical vignette during a Biology unit. Included is a copy of the vignette and I have identified some possible improvements that might lead to better outcomes. This may be helpful for other teachers who wish to try this strategy for themselves.

Introduction

Countless times we are told in our lives to learn from our mistakes and those of others. While it is misleading to refer to inaccurate scientific ideas as mistakes, there are ideas that once were esteemed in science and are now disregarded. Research indicates that many children develop alternative conceptions of scientific concepts that are consistent with historical developments of scientific concepts (Van Driel, De Vos & Verloop, 1998). In this paper, it is suggested that these alternative conceptions and cognitive barriers can be used as an opportunity for learning, particularly with the use of historical vignettes about science.

Historical vignettes were developed as an instructional tool by Wandersee (1992). The distinguishing feature of the vignette is the set up of a conflict within the story relevant to a period or finding in science history. This conflict is designed to engage students to think about the situation and generate interest in the problem presented. One may wish to ask students for their interpretation of the material and the courses of action they would be likely to take in the proponent's shoes. Roach and Wandersee (1995) describe the purposes of the Historical vignette as

> "…[to] provide content information, and promote examination of the nature of scientific enterprise by generating discussion. They help the students connect the present and the past, show the evolution of the ideas they are learning, and make the information more interesting." (p. 365)

One of the goals of the Historical vignette is to humanise Science. That is, 'the histories of science are the stories of humans constructing and applying scientific knowledge across the ages' (Roach & Wandersee, 1995, p. 367).

The Historical vignette can also demonstrate the process of science rather than the products. In schools, students are often taught science as a body of knowledge while the actual process, or the nature of science, is rarely mentioned (Roach & Wandersee, 1995). Erduran (2000), notes that aspects of philosophy, sociology, and history show that science is not merely a collection of facts. Science is an intricate subject matter that is influenced by, and has influence on, many other fields.

In this paper I describe my experience with writing and presenting an historical vignette. There were several purposes for using the vignette in the Biology unit described here. First, I wanted a lively introduction to a unit on molecular genetics; second, was to generate discussion in the class; third, was to generate interest in the students in the hope that they would pursue some of the issues discussed through further reading. The fourth intention was to help students in realising the importance of prior knowledge to new scientific discoveries (an element of the nature of science). The vignette was presented in the first lesson of a four-lesson sequence. The other lessons involved a discussion of the structure of DNA, the relationship between structure and function and the processes of transcription and translation.

Designing the Historical vignette

I designed an historical vignette (Appendix) focussing on the discovery of the structure of DNA. The vignette was presented in a year 12 Biology class to which I had been allocated when I was a pre-service teacher from James Cook University. The basic structure of the vignette was based on the outline given by Roach and Wandersee (1993, 1995).

The vignette was written in the form of a role-play (Appendix). The content of the story was obtained from a number of texts. Sections of the story were taken from Watson & Stent's (1981) account of the famous discovery in their book 'The Double Helix'. Aspects of Linus Pauling's life were taken from the Oxford 'A Dictionary of Scientists' (a good reference for information about many Scientist's lives and achievements). Other materials used as references were obtained from websites and various journal articles (for example, Strathern, 2000, Feynman, 1998, Watson & Stent, 1981, www.woodrow.org/teachers/chemistry/institues/1992/biology, Klug, 1968). These contributed to my knowledge base, which was used in the ensuing discussion about the vignette.

Implementing the historical vignette

The various characters of the story were allocated to students in the class who then read the play. Imbedded in the story was a set of questions for my use. The questions were interruptions in the story-line designed to focus the students' attention on certain points I considered of value. This allowed students to provide input to the story. The story ended with a question seeking to evoke further discussion.

Before commencing the story, I told the class that the purpose was to capture their interest and possibly stimulate them to do some further reading on some of the issues covered. I had extra material prepared to give to students who approached me about this reading.

I made explicit that not all of the events in the story took place as they were presented. This was done to ensure that students understood that while the science was accurate, some of the elements of the story were designed for entertainment rather than accuracy (in case students began believing in ghosts). After reading and discussing the vignette, students were asked to write personal reflections on the story.

Outcomes of the presentation : Student reflections

Having read the students reflections, the story was well received. Nevertheles, I felt that the questions took away from the impact the story had. While I cannot make such a judgement based on the students' opinions of the story, this was certainly a feeling I had while it was being delivered. One explanation for this lies in the analysis of the questions used. For example, in the teacher copy of the vignette (Appendix), one question asks if the students can suggest why there was a problem with the DNA structure proposed by Linus Pauling? The answer to this question was not included in the text they had just read. Thus, it could be difficult for students to offer even basic ideas. Aside from this, this type of question (while I was open to any suggestion whatsoever) is a very difficult one to answer from a student's perspective. This problem can be attributed to a lack of experience in using suitable questioning techniques. Again, I wish to stress that I was not seeking a correct answer but simply for the students to be engaged in thinking about the possibilities regardless how inaccurate they may have been. What was required, in this instance, was a sequence of questions at the end of the story to generate more thought and to bridge some of the concepts presented. I am happy to

report that despite the poor design of the question, students did offer some suggestions (with a little coaxing).

The other two questions in the historical vignette were designed to evoke some affective responses from the students and these were somewhat more successful than the first. This may not have been the case during the question or discussion period but it was evidant in the students reflections. For example, in comments such as 'I reckon Linus Pauling should have still got the Nobel prize because his was the work that actually exposed that his model was wrong' and this 'And it was him [Linus] that made the true discovery not Crick and Watson' and then this 'The story gave insight into the fact that Scientists are still stealing other's [scientists] ideas even today' [comment based on discussion after a question in the story]. It was pleasing to see that the students had been touched in some way by Pauling's unfortunate episode, however their comments did raise some concern. That is, the students may have taken entertaining aspects of the story too literally. Perhaps greater care should be taken not to give an unfavourable impression of Watson and Crick.

After the presentation of the Historical vignette, I attempted to engage the students in a conversation over the concepts introduced. The students did not offer their opinion easily. The impression this gave me was that some students felt as if they may not be doing real schoolwork. From a personal perspective, I think that some of their comments about the vignette illustrate the opposite. A student noted one of the points I had purposely tried to make about scientific inquiry: 'It [the Historical vignette] also explains that in any scientific circumstance, already known information should play a part in how results are observed'. This comment is one I find very encouraging because this student had understood one of the essential aspects, underlying any scientific inquiry (the Nature of Science). The following questions that one student raised in her reflection were encouraging : 'But how did he [Watson and Crick] discover it [DNA Structure] exactly? And what is so important about it?'. This student then expressed that it would be good to include these aspect in the story-line. This was similar to a comment made to me by one of the students who did not hand in her reflection. She thought that more scientific information could have been included in the story. In light of the comments made, I did remind students that the purpose of the story was that they would ask such questions and then perhaps search for the answers themselves. However, in light of her comments, the

story may generate more interest, for this year level, if more scientific information is included. Perhaps when one is presenting a vignette for the first time it is best to have a teacher directed presentation and to have a (scientifically) denser story-line. It may be necessary for the students to have the opportunity to adjust to this different style of presentation in order to improve on its effectiveness. Overall, all the students said they enjoyed the story.

Based on the evaluations of the Historical vignette that were collected and on my interpretation of the success of the story, a number of improvements could be made to enhance its effectiveness. Foremost of these is the need to have a lively presentation. If students were involved in writing an Historical vignette they may have prepared costumes and performed a skit. If the Historical vignette is of the type that are read by the teacher to the class, then it is recommended that at least some humour be included and that the teacher add some expression to ensure that the atmosphere is lively and enjoyable. This line of thought has led me to consider other formats that may appeal to students.

Variations on the Theme of Historical vignettes and Other Possibilities

Another suggestion to those above is a variation of an historical vignette that may take the form of an episode of 'This is Your Life'. In such a story one may have a Scientist as the central character being visited by a Mike Munro stand-in, and a number of other Scientists may be introduced as significant others (to the research not necessarily to the Scientist's social life). Such a format would be optimal in situations where one wishes to create some debate between Scientists from opposing ideologies. Students could prepare such an episode and design some costumes or masks. As part of the assessment, students could compile a book, similar to the one used by Mike, containing the significant events and discoveries in the scientist's lives. This could also be used as a classroom resource or a personal resource that the students can add to at different times throughout the year.

Another format, which may have some appeal to students, could be a Jerry Springer style interview. This too would be especially useful for conflict style Historical vignettes by introducing Scientists with opposing views and then resolving the conflict

during the 'show' (something Judge Judy may lend a hand in doing). Such modifications of formats may be more relevant to students as they can relate to the style being used.

An interesting format is that suggested by Wandersee and Roach (1998) is an Interactive Historical vignette. Here the students can dress as the Scientists of choice or simply display a portrait of the Scientist in question. A useful resource for this is the Woodrow webpage (www.woodrow.org/teachers/chemistry/institues/1992/biology). This site contains stories, in biographical interview style, of a large number of scientists. Included in this site are caricatures of Scientists. These can be enlarged and used as masks. Along these lines, one may also design cartoons that need not be interactive but may have more appeal to students than plain text. The story would follow the format of an Historical vignette with questions embedded in the text to encourage students to think about the science. Such a story could be read in a whole group situation with pauses to answer the questions, or may just be used as an introduction to a unit of work or as a summary of main points in a unit. The importance here is to decide upon the outcomes the students are to achieve and if the format chosen will accurately represent these outcomes. The variations suggested here are not variations of the structure as described by Roach and Wandersee (1993,1995), rather, they are variations on the theme.

Conclusion

My experience with writing and presenting the historical vignette suggests that it is a useful heuristic device. While the first attempt had room for some fine tuning, it still proved to be an effective means to engage students in discussion about science. I would like to suggest other possibilities for the historical vignette (or the History of Science) have been identified in this paper. One of the most effective uses for the vignette could be to show the struggle of minority groups (for example, the unnoticed contribution of some female scientists) in gaining recognition in scientific disciplines. This article has merely exposed the tip of the iceberg.

In this paper I have demonstrated the potential for generating discussion about science in the classroom through the use of historical vignettes. Part of learning science involves learning the language of science and the processes of science. Historical vignettes may be one tool in a teachers' repertoire which can help achieve this goal.

Current movements in Science education have placed some emphasis on literacy skills in science (Wellington & Osborne, 2001). What better way than using a historical vignette can one suggest to achieve this goal?

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I. Appendix

A Twist of Fate

Characters :

Narrator

Tracey – Biology student from Cityville

Anthony - Biology student from Cityville

Dr. Linus Pauling – American chemist (1901-1994)

Narrator : This is a story about two Cityville students who experienced a strange encounter while on a Biology camping trip. The students, Anthony and Tracey were walking through the forest at night. After some time they lost their way and didn't know how to get back to the campsite. To their surprise though, their walk took on a new twist when they made an unusual find and a strange friendship. When they finally made it back to the camp, they retold their story to their teachers and friends, few of which believed them.

Anthony : We were bored so we had decided to go walking for a while. We were following the marked track but then we must have strayed a little.

Tracey : That is when everything seemed to take a turn for the worst. We couldn't work out how to get back to the walking track.

Anthony : As we walked along an unmarked track, we suddenly heard loud music coming from somewhere ahead. So we walked on hoping to find someone who may help us get out of the forest.

Tracey : All of a sudden, the rainforest cleared and we found that a cottage was the source of the music.

Anthony : We where never prepared for what we saw. The house was full of the ghosts of dead scientists partying like there was no tomorrow.

Tracey : Einstein opened the door and welcomed us in. None of the scientists took any great notice that we were there. It was as if they were expecting visitors and that it was normal for the ghosts of scientists to have a bash in the bush.

Anthony : Tracey and I looked around the room in hope to find someone who could help us. The choice was simple, we approached a ghost who was sitting alone and seemed to be mumbling to himself while twisting pipe cleaners together and laughing hysterically.

Anthony : We approached him slowly. As we came closer, I recognised him from some Chemistry lessons we had done. It was Linus Pauling, the man who had discovered the helical structure of proteins.

Tracey : Um- Excuse us Dr. Pauling….

Dr. Pauling : Yes, what, who is it ? Do I know you?

Tracey : No Dr. Pauling, we are Biology students from Cityville. We were camping and we had decided to go for a walk when we lost our way. Now we need help to get back to camp.

Dr. Pauling : Biology students hey ? I could have been the one to create the new advances in the field of Genetics were it not for a most unfortunate ordeal!

Narrator : Dr. Pauling looked quite distressed so Tracey and Anthony sat down to comfort him and hear his story.

Anthony : Please Dr. Pauling, tell us what you mean by that.

Dr. Pauling : You mean you don't know about the discovery of the structure of DNA! See, they don't even teach the whole truth out there these days.

Tracey : We have learnt that Watson and Crick discovered the structure. I think that one of my teachers once mentioned that you had something to do with it but we didn't really go into detail about it.

Dr. Pauling : HA, those two! They got all the credit and half of it was my work. Well, sit down kiddies because now I'll tell you the real story behind that discovery.

Back in the 50's, I was working in the US at Cal Tech University. I was working on the structure of the genetic material, DNA. In 1952, I published my results, which showed how the DNA molecule consisted of three strands coiled together in a helix. People read the paper and said that there were problems with the structure.

Question : What is the structure of the DNA molecule? Can anyone suggest why there was a problem with the structure that Dr. Pauling had suggested?

Dr. Pauling : As it turns out, Watson and Crick also received a copy of the paper I had written with my structure. They had realised that the structure I had drawn was wrong and they redrew it with only two helices (he says as he gives the pipecleaners a good twist). It was a mistake on my part that I would have realised sooner or later but they saw the opportunity and took it. Their structure was better because it agreed with all the available information on DNA at the time. Their model was also useful in explaining the DNA's function during cell division. As it turned out they received the Noble prize in Physiology and Medicine in 1962.

Tracey : So their model was better because it had more evidence to support it and also because it explained what happened during meiosis is that right?

Dr. Pauling : Precisely!

Anthony : Wow! So those guys hardly did any lab work, used all the data collected at the time and then solved the structure. I can see why you were a little annoyed. Well, we have to go now, and we will make sure we tell our friends and teachers about your story. But you have to tell us one last thing Dr. Pauling.

Dr. Pauling : Yes, what is it?

Anthony : Please tell us how to get out of the rainforest now!!

Question : Do you think that scientists should compete this way to solve a problem? Do you think that scientists still compete in this way?